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EXAMINER

WILSON, CHRISTIAN D

ART UNIT

PAPER NUMBER

2891

DATE MAILED: 11/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/828,958

Applicant(s)

BRASK ET AL.

Examiner

Christian Wilson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 April 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 9-2-05, 3-1-05, 11-26-04, 10-7-04, 6-8-04, 4-28-04
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☒ Other: search history.

## **DETAILED ACTION**

### ***Information Disclosure Statement***

1. The U.S. Patent application numbers listed in the applicant's information disclosure statement have been considered and listed on the enclosed Notice of References Cited as U.S. Patents and U.S. Pre-Grant Publications.

### ***Drawings***

2. The drawings are objected to because they include hand drawn figures and figure numbers. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Official Notice***

3. Official notice is taken of the following material properties. These values are found in the CRC Handbook of Chemistry and Physics.

<u>Element</u>	<u>Work Function (eV)</u>
Al	4.20
Co	5.0
Hf	3.9
Ni	5.22
Pd	5.22
Pt	5.64
Ru	4.71
Ta	4.25
Ti	4.33
Zr	4.05

***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1 – 8 and 10 are rejected under 35 U.S.C. 102(e) as being anticipated by

Madhukar *et al.*

Madhukar *et al.* (US 6,794,281) discloses a method of making a semiconductor device comprising forming a first dielectric layer **162** on a substrate **102**, forming a trench in the dielectric layer [Figure 6C], forming a second dielectric layer **108** on the substrate and in the trench, forming a first metal layer **110** on the first part of the second dielectric layer but not

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covering the second part of the second dielectric layer [Figure 6D], and forming a second metal layer 114 on the first metal layer and on the second part of the second dielectric layer [Figure 6E].

Regarding claims 2 and 3, Madhukar *et al.* further discloses a high-k dielectric material comprising a transition metal oxide material [column 2, lines 45-50].

Regarding claim 4, Madhukar *et al.* further discloses a first metal layer of Zr, Ti, Ta, or Al [column 3, lines 1-5], and a second metal layer comprising Pt or a conductive metal oxide [column 2, lines 65-67].

Regarding claim 5, Madhukar *et al.* further discloses a second metal layer of Zr, Ti, Ta, or Al, and a first metal layer comprising Pt or a conductive metal oxide [column 3, lines 20-35].

Regarding claims 6 and 7, Madhukar *et al.* further discloses metal thicknesses of 100 – 2000 Å [column 3, lines 53-55] and the metal layers inherently have work functions as claimed as shown in the Official Notice described above.

Regarding claim 8, Madhukar *et al.* further discloses a fill metal layer 116.

Regarding claim 10, Madhukar *et al.* further discloses forming the first metal layer by forming the first metal layer on both portions of the second dielectric layer and then removing the metal layer from the second part of the dielectric layer [column 3, lines 5-20].

### ***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Madhukar *et al.* in view of Gardner *et al.*

Madhukar *et al.* teaches the limitations of claim 1 as described above, but does not discuss an underlayer metal. Gardner *et al.* (US 6,255,698) teaches an underlayer metal in a high-k dielectric gate device [column 13, lines 30-45]. It would have been obvious to one of ordinary skill in the art since this layer provides improved adhesion and diffusion protection.

8. Claims 11 – 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madhukar *et al.* in view of Jeng.

Regarding claim 11, Madhukar *et al.* teaches a method of forming the first metal layer by depositing the first metal layer, masking and etching the metal over the second part of the dielectric layer, and removing the masking layer [column 3, lines 5-20]. Madhukar *et al.* does not discuss using a spin-on-glass (SOG) layer as a mask in the lithography process. Jeng (US 2003/0201121) teaches the use of SOG layer as a mask for a metal lithography process [0048]. It would have been obvious to one of ordinary skill in the art to use the SOG layer of Jeng in the method of Madhukar *et al.* since the SOG layer provides an enhanced etch rate difference between the mask and the underlying dielectric layer for better etch selectivity.

Regarding claim 12, Madhukar *et al.* teaches a method of making a semiconductor device comprising forming a first dielectric layer **162** on a substrate **102**, forming a trench in the dielectric layer [Figure 6C], forming a high-k dielectric layer **108** on the substrate and in the trench, forming a first metal layer **110** on the first part of the high-k dielectric layer but not covering the second part of the high-k dielectric layer [Figure 6D] by forming the first metal

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layer on both portions of the high-k dielectric layer and then removing the metal layer from the second part of the dielectric layer [column 3, lines 5-20], and forming a second metal layer **114** on the first metal layer and on the second part of the high-k dielectric layer [Figure 6E].

Madhukar *et al.* teaches a method of forming the first metal layer by depositing the first metal layer, masking and etching the metal over the second part of the dielectric layer, and removing the masking layer [column 3, lines 5-20]. Madhukar *et al.* does not discuss using a spin-on-glass (SOG) layer as a mask in the lithography process. Jeng teaches the use of SOG layer as a mask for a metal lithography process [0048]. It would have been obvious to one of ordinary skill in the art to use the SOG layer of Jeng in the method of Madhukar *et al.* since the SOG layer provides an enhanced etch rate difference between the mask and the underlying dielectric layer for better etch selectivity.

Regarding claim 13, Madhukar *et al.* further teaches a high-k dielectric material comprising a transition metal oxide material [column 2, lines 45-50].

Regarding claims 14 and 15, Madhukar *et al.* further teaches metal thicknesses of 100 – 2000 Å [column 3, lines 53-55] and the metal layers inherently have work functions as claimed as shown in the Official Notice described above.

Regarding claim 16, Madhukar *et al.* teaches a method of making a semiconductor device comprising forming a first dielectric layer **162** on a substrate **102**, forming a trench in the dielectric layer [Figure 6C], forming a high-k dielectric layer **108** on the substrate and in the trench, forming a first metal layer **110** with a thickness of 100 – 2000 Å [column 3, lines 53-55] on the first part of the high-k dielectric layer but not covering the second part of the high-k dielectric layer [Figure 6D] by forming the first metal layer on both portions of the high-k

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dielectric layer and then removing the metal layer from the second part of the dielectric layer [column 3, lines 5-20], and forming a second metal layer **114** with a thickness of 100 – 2000 Å [column 3, lines 53-55] on the first metal layer and on the second part of the high-k dielectric layer [Figure 6E]. Madhukar *et al.* teaches a method of forming the first metal layer by depositing the first metal layer, masking and etching the metal over the second part of the dielectric layer, and removing the masking layer [column 3, lines 5-20]. Madhukar *et al.* does not discuss using a spin-on-glass (SOG) layer as a mask in the lithography process. Jeng teaches the use of SOG layer as a mask for a metal lithography process [0048]. It would have been obvious to one of ordinary skill in the art to use the SOG layer of Jeng in the method of Madhukar *et al.* since the SOG layer provides an enhanced etch rate difference between the mask and the underlying dielectric layer for better etch selectivity.

Regarding claims 17 and 18, Madhukar *et al.* further teaches metal layers which inherently have work functions as claimed as shown in the Official Notice described above.

Regarding claims 19 and 20, Madhukar *et al.* further teaches a fill metal **116** of tungsten.

### ***Conclusion***

9. A copy of the search history is enclosed.
10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christian Wilson whose telephone number is (571) 272-1886. The examiner can normally be reached on weekdays, 7:30 AM to 4 PM.



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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Christian Wilson, Ph.D.  
Primary Examiner  
Art Unit 2891

CDW